COMPOSITIONAL VARIATION IN Cs, Mg, Fe-ENRICHED BERYL FROM COMMON PEGMATITE IN KOVÁŘOVÁ, SVRATKA UNIT, CZECH REPUBLIC

PŘIKRYL, J.*, NOVÁK, M. & GADAS, P.
Department of Geological Sciences, Masaryk University, Kotlářská 2, 611 37 Brno, Czech Republic
* E-mail: hanzii@mail.muni.cz

Beryl, a typical accessory mineral in granitic pegmatites, has quite variable composition tending to (i) beryl close to its ideal formula $Be_3Al_2Si_6O_{18}$ with minor contents of Na, Fe, Mg and H_2O; (ii) T-beryl with dominant substitution in the T(2)-site and CH-site leading to pezzottaite ($CsBe_2LiAl_2Si_6O_{18}$); (iii) O-beryl with dominant substitutions in the O-site and CH-site leading to the simplified general formula $R^+Be_3R^{3+}R^{2+}Si_6O_{18}$, where R^+ = Na, Cs; R^{3+} = Al, Fe^{3+}, Sc; and R^{2+} = Mg, Fe^{2+}. Unusual Cs,Mg,Fe-enriched beryl was found in common pegmatite from Kovářová, Svratka unit. It is built by mica schists, paragneisses, migmatites, orthogneisses, amphibolites and anatectic (?) pegmatites. Abundant fragments of pegmatite occur ~0.5 km N from Kovářová village. Based on these fragments, the pegmatite dike, ~50 cm thick and ~10 m long, is concordantly enclosed in medium-grained amphibolite (Hbl + $Plg_{An26–79}$ > Ttn + Ilm) with sharp contacts. The pegmatite has simple internal structure of (i) medium- to coarse-grained outer unit ($Plg_{An7–31}$ > Kfs > Qtz > Mu > Bt), ~1–2 cm thick, (ii) thin quartz + muscovite-rich zone (Qtz > Mu > Ab+Kfs) with rare biotite, typically developed between outer unit and (iii) coarse-grained inner unit (Kfs > Qtz > Ab > Mu) locally with crystals of (iv) blocky K-feldspar, up to 15 cm in size, and rare masses of smoky quartz, up to 5 cm in diameter. Beryl and garnet ($Alm_{48–72}Sps_{22–47}Prp_{1–6}Grs_{2–4}$; Y ≤ 0.5 wt% Y_2O_3) are common accessory minerals, whereas small grains (< 0.5-1 mm) of apatite, schorl, ilmenite, Th-enriched monazite-(Ce), xenotime-(Y) and zircon, and highly heterogeneous Nb,Ta,Ti-oxides are rare.

Two types of beryl variable in shape, size, position in pegmatite and composition were recognized based on EMPA and LA-ICP-MS study. Long prismatic crystals of **beryl I** (0.19–1.03 wt% Cs_2O, ≤ 0.05 Cs, 0.01–0.03 Na, 0.01–0.12 Mg, 0.04–0.16 Fe, all in *apfu*) with *c*/*a* ~5–10, (≤ 200 µm), are common in thin sections from the inner unit. They are homogeneous and do not contain inclusions of micas. Yellowish to greenish crystals of **beryl II** with *c*/*a* ~5, locally up to 1 cm long, are common in the inner unit and exhibit complex zoning. The complexly zoned crystals of **beryl II** studied in detail yielded several distinct compositional types (generations). Volumetrically dominant (~75–90 vol%) **beryl IIa** (1.07–1.23 wt% Cs_2O; 0.04–0.05 Cs, 0.04–0.05 Na, 0.03–0.06 Mg, 0.12–0.14 Fe, all in *apfu*) forms central parts of these crystals and contains numerous small inclusions of muscovite + Cs-annite (≤ 20 µm). Beryl IIa is heterogeneous in BSE images; Cs-enriched and Cs-poor portions are oriented parallel to *c*-axis and the latter are always close to the inclusions of muscovite + Cs-annite. Commonly thin outer rims (≤ 500 µm thick) of **beryl IIb** (0.04–0.14 wt% Cs_2O, 0.13–0.20 Na, 0.12–0.18 Mg, 0.05–0.08 Fe, all in *apfu*) are developed along prismatic and basal planes. Beryl IIb is heterogeneous, but no mica inclusions were identified. Both primary types of beryl IIa and IIb underwent later recrystallizations and were replaced by three younger beryl types (generations). **Beryl IIc** (0.13–0.17 wt% Cs_2O, 0.06 Na, 0.03–0.04 Mg, 0.07–0.09 Fe, all in *apfu*) forms irregular rather homogeneous masses, up to 200 µm in size, within beryl IIa. These masses, free of any inclusions, do not show any evident orientation to *c*-axes and have diffusive contacts to its precursor – beryl IIa. Small subhedral portions of **beryl IId** (Cs_2O b.d.l., 0.04 Na, 0.03 Mg, 0.01 Fe, all in *apfu*), ~50 µm in size, are oriented parallel to *c*-axis and replace host beryl IIb exclusively on basal planes. Late **beryl IIe** (≤ 0.14 wt% Cs_2O, 0.17 Na, 0.02 Mg, 0.01 Fe, all in *apfu*) forms very thin irregular veinlets, up to ~30 µm thick, cutting beryl IIa. Primary beryl I and beryl IIa have similar compositions, whereas primary beryl IIb in rims is evidently Na,Mg-enriched but Cs- and in part Fe-depleted. Recrystallization of primary beryl IIa,b yielded Cs-depleted compositions closer to the ideal formula (beryl IIc,d); late beryl IIe is evidently Na-enriched.

Several types of beryl distinct in textures (e.g., orientation to *c*-axes), presence of mica inclusions and chemical composition point out rather complex process of the beryl and pegmatite formation including primary zoning and late hydrothermal recrystallizations. The common pegmatite likely of anatectic origin shows rather simple internal structure; hence, combination of elevated contents of Mg + Fe and of Cs in beryl is very unusual. Moreover, high Cs in beryl and in Cs-annite, Mn in garnet, Ta in Nb,Ta,Ti-oxides and Th in monazite. They indicate quite a high degree of fractionation of the pegmatite, which is hardly consistent with its potential anatectic origin. Consequently, (i) the pegmatite has a magmatic source and high Mg in beryl is product of external contamination or evolved mica-rich rocks of the Svratka Unit underwent partial low-percentage anatexis producing such strange compositions (migmatites contain up to 103 ppm Cs, pers. comm. D. Buriánek).

This work was supported by the research project GAČR P210/10/0743 to MN and PG.